

FORM PTO-1390 (Modified)
(REV. 1-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

L9289.01138

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/856245

INTERNATIONAL APPLICATION NO.

PCT/JP00/06541

INTERNATIONAL FILING DATE

September 25, 2000

PRIORITY DATE CLAIMED

September 29, 1999

TITLE OF INVENTION

Transmitting Apparatus and Transmitting Method

APPLICANT(S) FOR DO/EO/US

Keiichi KITAGAWA, Mitsuru UESUGI and Yoshiko SAITO

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Claim for Priority with PCT/IB/304**PCT/IB/308****PCT/RO/101**

U.S. APPLICATION NO. (If known, SEE 7 OR 99/856245)	INTERNATIONAL APPLICATION NO. PCT/JP00/06541	ATTORNEY'S DOCKET NUMBER L9289.01138
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24. The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **\$1000.00**
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **\$860.00**
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **\$710.00**
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **\$690.00**
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **\$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =**\$860.00**

Surcharge of **\$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	15 - 20 =	0	x \$18.00
Independent claims	6 - 3 =	3	x \$80.00

\$0.00**\$240.00**Multiple Dependent Claims (check if applicable). ☐**\$0.00****TOTAL OF ABOVE CALCULATIONS =****\$1,100.00**

☐ Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.

\$0.00**SUBTOTAL =****\$1,100.00**

Processing fee of **\$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).

\$0.00**TOTAL NATIONAL FEE =****\$1,100.00**

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). ☒

\$40.00**TOTAL FEES ENCLOSED =****\$1,140.00**

Amount to be:
refunded \$
charged \$

- a. ☒ A check in the amount of **\$1,140.00** to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **19-4375**. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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28,732

REGISTRATION NUMBER

May 18, 2001

DATE

DESCRIPTION

TRANSMITTING APPARATUS AND TRANSMITTING METHOD

Technical Field

5 The present invention relates to a transmitting apparatus and a transmitting method for use in a mobile communication system.

Background Art

10 In a mobile communication system, because of arrival of a plurality of transmitted waves at a receiver after being reflected and diffracted and movement of the receiving apparatus itself, amplitude and phase of signals received at the
15 receiver are drastically varied.

 In the mobile communication system, it is necessary to compensate for variations in amplitude and phase of received signals at the receiver in order to keep communication quality well. The
20 similar compensation is also required at the time of performing processing such as synchronous detection, delay detection, and the like.

 As a method for compensating for variations in amplitude and phase of received signals, there is
25 generally used a method in which variations in amplitude and phase of a channel are estimated by an adaptive equalizer to shape the waveforms of received signals adaptively and to reduce influence

of interference between signals.

However, in the case where the channel variation is considerably fast due to high-speed fading, the channel estimation by the adaptive
5 equalizer cannot sufficiently follow the variation in the channel, causing a problem in which an error rate characteristic is deteriorated.

Disclosure of Invention

10 It is an object of the present invention is to provide a transmitting apparatus and a transmitting method in which an adaptive equalizer can hold sufficient following performance so that communication quality can be satisfactorily
15 maintain without increasing the number of apparatus components even in the case where the channel variation is considerably fast due to high-speed fading.

This object can be achieved by performing
20 transmission after increasing a symbol rate when the channel variation is considerably fast due to high-speed fading and making the channel variation between symbols or in a burst relatively minute.

25 Brief Description of Drawings

FIG. 1 is a block diagram illustrating the configuration of a transmitting apparatus and that of a receiving apparatus according to a first

embodiment of the present invention;

FIG. 2A is a view illustrating a frequency band corresponding to a symbol rate;

FIG. 2B is a view illustrating a frequency band
5 corresponding to a symbol rate;

FIG. 3A is a view illustrating the relationship between the symbol rate and a channel variation;

FIG. 3B is a view illustrating the relationship between the symbol rate and a channel variation;

FIG. 4 is a block diagram illustrating the
10 configuration of a transmitting apparatus and that of a receiving apparatus according to a second embodiment of the present invention;

FIG. 5 is a view illustrating the relationship
15 between the symbol rate and a BER characteristic; and

FIG. 6 is a block diagram illustrating the
configuration of a transmitting apparatus and that of a receiving apparatus according to a third
20 embodiment of the present invention.

Best Mode for Carrying Out the Invention

The following will explain embodiments of the present invention with reference to the drawings
25 accompanying herewith.

(First embodiment)

FIG. 1 is a block diagram illustrating the configuration of a transmitting apparatus and that

of a receiving apparatus according to a first embodiment of the present invention.

In a transmitting apparatus 100 illustrated in FIG. 1, a channel variation estimating section 101
5 estimates a channel variation quantity between the transmitting apparatus 100 and a receiving apparatus 200, and outputs an estimated result to a symbol rate determining section 102. It is noted that a channel variation estimating method includes
10 a method for measuring a reception level of received signal by the receiving apparatus (not shown), which is mounted on a base station apparatus with the transmitting apparatus 100, to perform estimation based on the measured result.

15 The symbol rate determining section 102 determines a symbol rate based on the estimated channel variation quantity. Then, the symbol rate determining section 102 outputs a signal indicative of the determined symbol rate to a frame structuring
20 section 103, a baseband modulating section 104, a band variable filter 105, and a synthesizer 106.

The frame structuring section 103 performs frame structuring process in which a frame length is determined based on the determined symbol rate,
25 transmitting data is divided into frames, and a control signal such as a pilot symbol and the like is inserted into each frame.

The baseband modulating section 104 modulates

an output signal of the frame structuring section 103 to a baseband signal based on the determined symbol rate. The band variable filter 105 forms a filter based on the determined symbol rate, and
5 restricts a transmitting band of an output signal of the baseband modulating section 104.

The synthesizer 106 controls a central frequency of a carrier wave based on the determined symbol rate, and outputs the carrier wave of the
10 corresponding central frequency to a multiplying section 107. Here, as illustrated in the frequency band of FIGS. 2A and 2B, the synthesizer 106 makes a central frequency f_{c2} where the symbol rate is low different from a central frequency f_{c1} where the
15 symbol rate is high to be tilted toward one side of an allowable bandwidth to which a frequency band is allocated. This makes it possible to improve frequency use efficiency as an overall system.

It is noted that FIG. 2A indicates the frequency
20 band when the symbol rate is high, and FIG. 2B indicates the frequency band when the symbol rate is low.

The multiplying section 107 multiplies the output signal of a band variable filter 105 by the
25 carrier wave outputted from the synthesizer 106. A BPF (Band Pass Filter) 108 passes only an output signal component contained in a given frequency band among output signal components of the multiplying

section 107. A transmitting antenna 109 radio transmits an output signal of BPF 108 to the receiving apparatus 200.

In the receiving apparatus 200 illustrated in FIG. 1, a receiving antenna 201 receives a signal transmitted from the transmitting apparatus 100. BPF 202 passes only a component contained in a given frequency band among output signal components received by the receiving antenna 201.

A symbol rate detecting section 203 detects a symbol rate of the received signal, and outputs a signal indicative of the symbol rate to a synthesizer 204, a band variable filter 206, a baseband demodulating section 207, and an adaptive equalizer 208. As a method for detecting the symbol rate, there is a method in which the transmitting apparatus 100 multiplexes information of the symbol rate into transmitting data to detect information of symbol rate from the demodulated received signals, and a method in which the transmitting apparatus 100 demodulates the received signals with a symbol rate as a candidate to estimate a symbol rate from the demodulation result.

The synthesizer 204 controls a central frequency of a carrier wave based on the detected symbol rate, and outputs the carrier wave of the corresponding central frequency to a multiplying section 205. The multiplying section 205 multiplies

the output signal of BPF 202 by the carrier wave outputted from the synthesizer 204.

The band variable filter 206 forms a filter based on the detected symbol rate, and restricts the band of an output signal of the multiplying section 205 to generate a baseband signal. A baseband demodulating section 207 demodulates the baseband signal outputted from the band variable filter 206 based on the detected symbol rate.

10 An adaptive equalizer 208 performs equalizing process in which the waveform of the output signal of the baseband demodulating section 207 is shaped to reduce influence of interference between signals, and extracts received signal. Even if a delay wave exists, the channel estimation is performed to make it possible to estimate the corresponding delay wave and equalize it if the delay wave is within an equalization-capable range.

An explanation will be next given of the relationship between the symbol rate and the channel variation using FIGS. 3A and 3B. A horizontal axis in each of FIGS. 3A and 3B indicates time, and a vertical axis is a phase variable quantity. FIG. 3A shows a case in which the symbol rate is low, and FIG. 3B shows a case in which the symbol rate is high.

In the case where the symbol rate is low as illustrated in FIG. 3A, transmitting time T_{s1} per one symbol becomes long and a phase variable

quantity $\Delta \theta 1$ becomes large during this time. While, in the case where the symbol rate is high as illustrated in FIG. 3B, transmitting time T_{s2} per one symbol becomes short and a phase variable
 5 quantity $\Delta \theta 2$ becomes small during this time. Though the above explained the phase variable quantity of the channel, the same can be applied to time variation relating to amplitude.

Thus, since the symbol rate is increased to
 10 lessen the channel variable quantity relatively, the symbol rate of the transmitting signal is increased when the channel variable quantity is large, making it possible for the adaptive equalizer of the receiving apparatus to hold sufficient
 15 following performance.

Similarly, since the symbol rate is increased to delay variations in time relatively, it is possible to compensate for variations in time in connection with processing such as synchronous
 20 detection of the receiving apparatus, delay detection, and the like. It is also possible to compensate for variations in time in connection with phase rotation due to a frequency offset.

Here, it is assumed that the symbol rate
 25 determining section 102 determines a symbol rate such that the product of transmitting time T_s per one symbol, namely, the reciprocal of symbol rate and the channel variable quantity f_D becomes a

constant value. This makes it possible to determine an appropriate symbol rate by a simple calculation processing.

Moreover, since the signal can be transmitted
5 for a short time when the symbol rate is high, the transmitting apparatus 100 may transmit the signal in only a section with a high reception level.

This makes it possible to reduce power consumption and to increase channel use efficiency
10 as an overall system.

(Second embodiment)

FIG. 4 is a block diagram illustrating the configuration of the transmitting apparatus and that of the receiving apparatus according to a
15 second embodiment of the present invention. In the transmitting apparatus and the receiving apparatus illustrated in FIG. 4, the same reference numerals as those of FIG. 1 are added to the configuration parts common to FIG. 1, and the explanation is
20 omitted.

In FIG. 4, the transmitting apparatus 100 adopts the configuration in which the channel variation estimating section 101 and symbol rate determining section are deleted from FIG. 1 and a
25 demodulating section 401 and a symbol rate extracting section 402 are added to FIG. 1. Moreover, the receiving apparatus 200 adopts the configuration in which the symbol rate detecting

section 203 is deleted from FIG. 1 and a channel variation estimating section 301, a symbol rate determining section 302 and a demodulating section 303 are added to FIG. 1. In FIG. 4, it is noted that
 5 the antenna 109 and the antenna 201 serve as both a transmitting antenna and a receiving antenna.

The channel variation estimating section 301 estimates a channel variable quantity of received signals, and outputs a signal indicative of a
 10 channel variable quantity to the symbol rate determining section 302. The symbol rate determining section 302 determines a symbol rate based on the estimated channel variable quantity, and outputs a signal indicative of a symbol rate to
 15 the demodulating section 303. The demodulating section 303 demodulates the signal indicative of the symbol rate and transmits it to the antenna 201.

A demodulating section 401 demodulates a signal indicative of a symbol rate received by the
 20 antenna 109, and outputs it to a symbol rate extracting section 402. The symbol rate extracting section 402 extracts the symbol rate from the demodulated signal, and outputs a signal indicative of the extracted symbol rate to the frame
 25 structuring section 103, the baseband modulating section 104, the band variable filter 105, and the synthesizer 106.

Thus, the receiving apparatus determines the

symbol rate and the transmitting apparatus transmits transmitting data in accordance with the symbol rate determined by the receiving apparatus. This makes it possible to transmit the symbol rate at which the receiving apparatus can decode easiest.

In the case where the receiving apparatus 200 is integral with the transmitting apparatus, information indicative of the symbol rate outputted from the symbol rate determining section 302 may be multiplexed into transmitting data to be transmitted.

(Third embodiment)

The first and second embodiments explained the case in which the symbol rate determining section 102 or the symbol rate determining section 302 determined the symbol rate of transmitting data based on only the channel variable quantity.

However, when the symbol rate is increased even in the case where the same delay wave is used, the number of delay symbols is relatively increased and the number of delay symbols, which can be equalized by the adaptive equalizer, is fixed by the number of taps of the adaptive equalizer. For this reason, in the case where the symbol rate continues to be increased, the delay wave exceeding the equalization-capable range exists, causing the problem in which performance of the adaptive equalizer is deteriorated.

For example, a delay wave with $1\mu\text{s}$ existing in the radio channel is a delay wave of one symbol delay when the symbol rate is 1Msps and a delay wave of two symbol delay when the symbol rate is 2Msps.

5 In the case where the adaptive equalizer with 5 taps is used, the delay wave up to 4-symbol delay can equalized but the delay wave with more than 4 symbol delay cannot be equalized.

10 Namely, in the case where the delay wave with $1\mu\text{s}$ exists, delay time is within 4 symbols when the symbol rate is less than 4Msps, so that the adaptive equalizer can equalize the corresponding delay wave. However, when the symbol rate is more than 4Msps, the adaptive equalizer cannot equalize the corresponding delay wave and performance of
15 the adaptive equalizer is deteriorated.

FIG. 5 is a view illustrating the relationship between the symbol rate and an error rate (BER) characteristic under environment where a channel variation with a predetermined quantity and a delay
20 wave with a predetermined delay time exist.

As illustrated in FIG.5, when the number of delay symbols of the delay wave is within the equalization-capable range, the channel variable quantity due to fading relatively becomes small with
25 an increase in the symbol rate, so that the error rate characteristic is improved. While, when the number of delay symbols of the delay wave exceeds the equalization-capable range, the error rate

characteristic is deteriorated by influence of the delay wave with the increase in the symbol rate.

Accordingly, the third embodiment determines an optimal symbol rate X whose error rate becomes
5 minimum by the channel variable quantity and the delay time of the delay wave.

FIG.6 is a block diagram illustrating the configuration of the transmitting apparatus and that of the receiving apparatus according to a
10 second embodiment of the present invention. In the transmitting apparatus and the receiving apparatus illustrated in FIG. 6, the same reference numerals as those of FIG. 1 are added to the configuration parts common to FIG. 1, and the explanation is
15 omitted.

In FIG. 6, the receiving apparatus 200 has the same configuration as that of FIG.1, and the transmitting apparatus 100 adopts the configuration in which a delay profile generating section 501 is
20 added to FIG.1.

The delay profile generating section 501 generates a delay profile of the signal received by the receiving apparatus (not shown) mounted on the base station apparatus together with the
25 transmitting apparatus 100, and outputs the generated delay profile to the symbol rate determining section 102.

The symbol rate determining section 102 holds

a reference table that provides a symbol rate whose error rate becomes minimum from the channel variable quantity and time delay of the delay wave. Then, the symbol rate determining section 102 inputs the
5 channel variable quantity from the variation estimating section 101, and inputs the delay profile from the delay profile generating section 501, and determines a symbol rate based on the reference table.

10 This determined symbol rate is an optimal symbol rate at which the receiving apparatus 200 can decode easiest, and the receiving apparatus 200 can keep the communication quality satisfactory.

Moreover, a table with consideration given to
15 not only delay time but also a pass model in which delay time of the delay wave of each pass and the level are modeled is prepared, and this makes it possible to select an optimal symbol rate at which the receiving apparatus 200 can decode easiest more
20 accurately.

Additionally, as illustrated in the second embodiment, the receiving apparatus determines the symbol rate and the transmitting apparatus can transmit transmitting data in accordance with the
25 symbol rate determined by the receiving apparatus. In this case, the channel varying section and the delay profile generating section are added to the receiving apparatus 200.

As is obvious from the aforementioned explanation, according to the transmitting apparatus and the transmitting method of the present invention, the symbol rate can be adaptively changed
5 in accordance with the measured channel variable quantity, and this makes it possible for the adaptive equalizer to hold sufficient following performance and to maintain communication quality satisfactory without increasing the number of
10 apparatus components even in the case where the channel variation is considerably fast due to high-speed fading.

This application is based on the Japanese Patent Application No. HEI11-275688 filed on
15 September 29, 1999, entire content of which is expressly incorporated by reference herein.

Industrial Applicability

The present invention is suitable for use in
20 a base station apparatus and a communication terminal apparatus in a mobile communication system such a cellular phone.

CLAIMS

1. A transmitting apparatus comprising:

symbol rate determining means for determining a
5 symbol rate of a transmitting signal based on a
channel variable speed between transmission and
reception; and

transmitting means for radio transmitting data
based on said symbol rate.

10 2. The transmitting apparatus according to claim 1,
wherein said symbol rate determining means
determines a symbol rate such that the product of
transmitting time per one symbol and the channel
variable speed becomes a constant value.

15 3. The transmitting apparatus according to claim 1,
wherein said symbol rate determining means
determines a symbol rate whose error rate becomes
minimum based on the channel variable speed and
relative delay time of multipaths.

20 4. The transmitting apparatus according to claim 1,
wherein said symbol rate determining means
determines a symbol rate whose error rate becomes
minimum based on the channel variable speed and a
delay profile.

25 5. The transmitting apparatus according to claim 1,
further comprising carrier wave frequency
controlling means for controlling a central
frequency of a carrier wave based on the symbol rate.

6. The transmitting apparatus according to claim 1, wherein said transmitting means transmits a signal only the period when received signal level is high.

7. The transmitting apparatus according to claim 1,
5 wherein said symbol rate determining means extracts information of the symbol rate from a signal transmitted from the other end of communication.

8. A receiving apparatus comprising:

receiving means for extracting received data
10 from a signal transmitted from the transmitting apparatus described in claim 7;

channel variation estimating means for
estimating a channel variation based on the received data;

15 symbol rate determining means for determining a symbol rate based on the estimated channel variation; and

transmitting means for transmitting a signal
indicative of the determined symbol rate to said
20 transmitting apparatus.

9. A base station apparatus having a transmitting apparatus thereon, said transmitting apparatus comprising:

symbol rate determining means for determining a
25 symbol rate of a transmitting signal based on a channel variable speed between transmission and reception; and

transmitting means for radio transmitting data

based on said symbol rate.

10. A base station apparatus having a receiving apparatus thereon, said receiving apparatus comprising:

5 receiving means for extracting received data from a signal transmitted from the transmitting apparatus described in claim 7;

channel variation estimating means for estimating a channel variation based on the received data;

symbol rate determining means for determining a symbol rate based on the estimated channel variation; and

transmitting means for transmitting a signal indicative of the determined symbol rate to said transmitting apparatus.

11. A communication terminal apparatus having a transmitting apparatus thereon, said transmitting apparatus comprising:

20 symbol rate determining means for determining a symbol rate of a transmitting signal based on a channel variable speed between transmission and reception; and

transmitting means for radio transmitting data based on said symbol rate.

12. A communication terminal apparatus having a receiving apparatus thereon, said receiving apparatus comprising:

receiving means for extracting received data from a signal transmitted from the transmitting apparatus described in claim 7;

channel variation estimating means for
5 estimating a channel variation based on the received data;

symbol rate determining means for determining a symbol rate based on the estimated channel variation; and

10 transmitting means for transmitting a signal indicative of the determined symbol rate to said transmitting apparatus.

13. A transmitting method wherein a channel variable speed between transmission and reception is
15 detected to increase a symbol rate of a transmitting signal in an increase in said channel variable speed.

14. A transmitting method wherein a channel variable speed between transmission and reception is
20 detected to determine a symbol rate of a transmitting signal having the highest error rate characteristic from the channel variable speed and relative delay time of multipaths.

15. A transmitting method wherein a channel variable
25 speed between transmission and reception is detected to determine a symbol rate of a transmitting signal having the highest error rate characteristic from the channel variable speed and

[illegible]

ABSTRACT

A channel variation estimating section 101 estimates a channel variable quantity between a transmitting apparatus 100 and a receiving apparatus 200. A symbol rate determining section 102 determines a symbol rate based on the channel variable quantity, and when the channel variation is considerably fast due to high-speed fading, transmission is carried out after increasing the symbol rate to make the channel variation between symbols or in a burst relatively minute. This makes it possible for the adaptive equalizer to hold sufficient following performance and to maintain communication quality satisfactory without increasing the number of apparatus components even in the case where the channel variation is considerably fast.

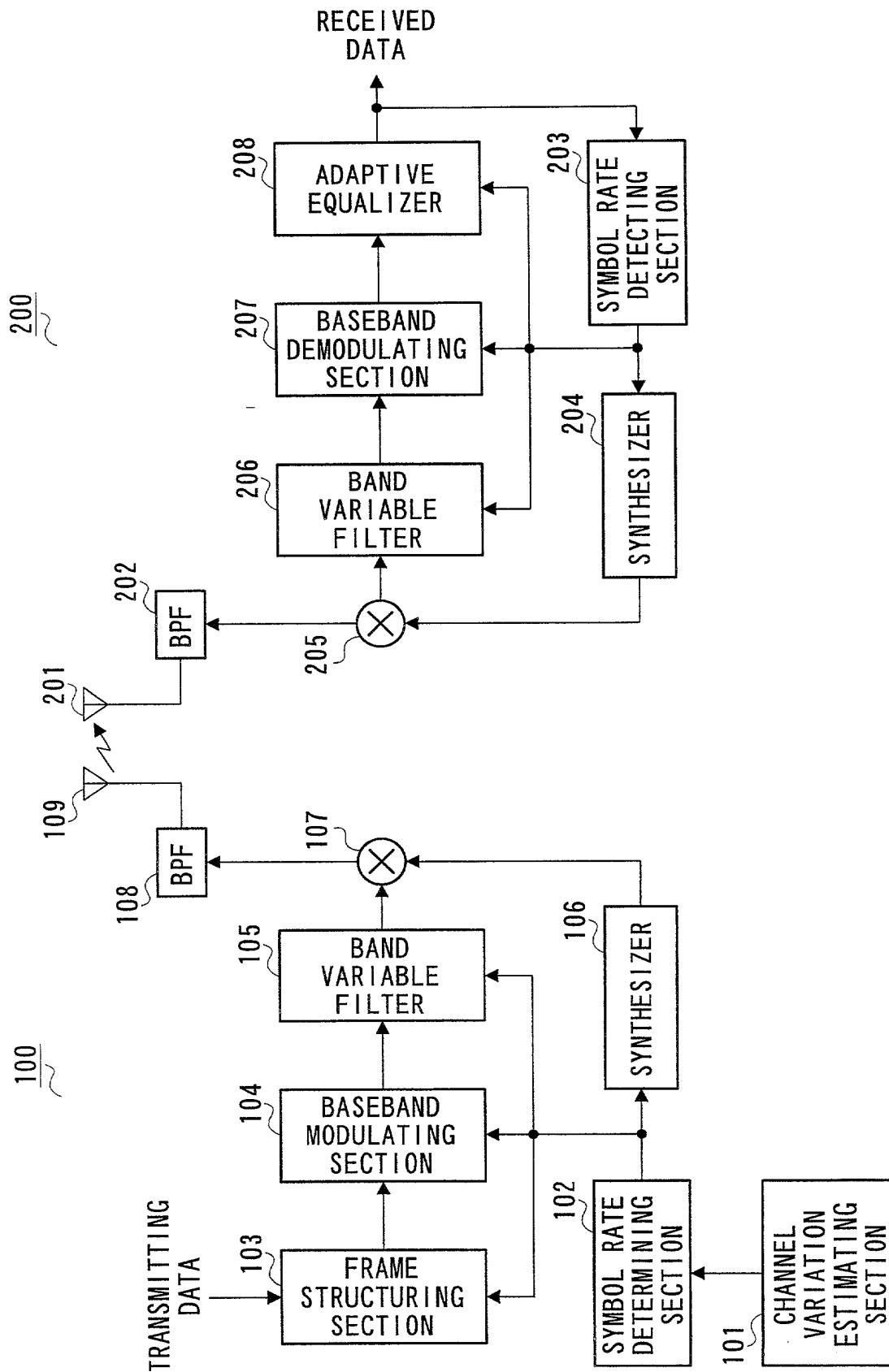


FIG. 1

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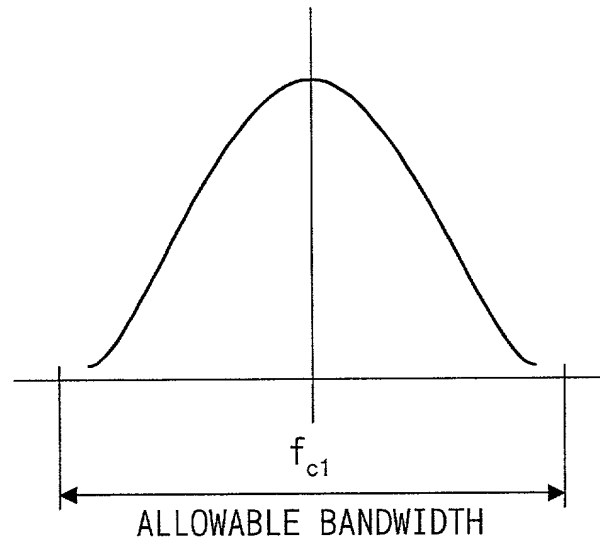


FIG. 2A

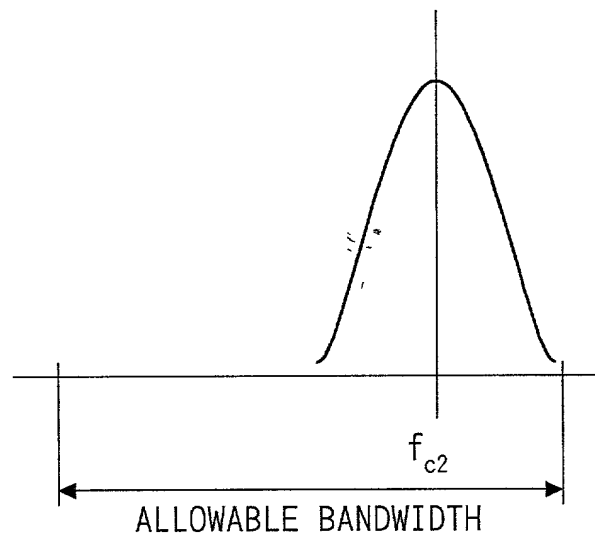


FIG. 2B

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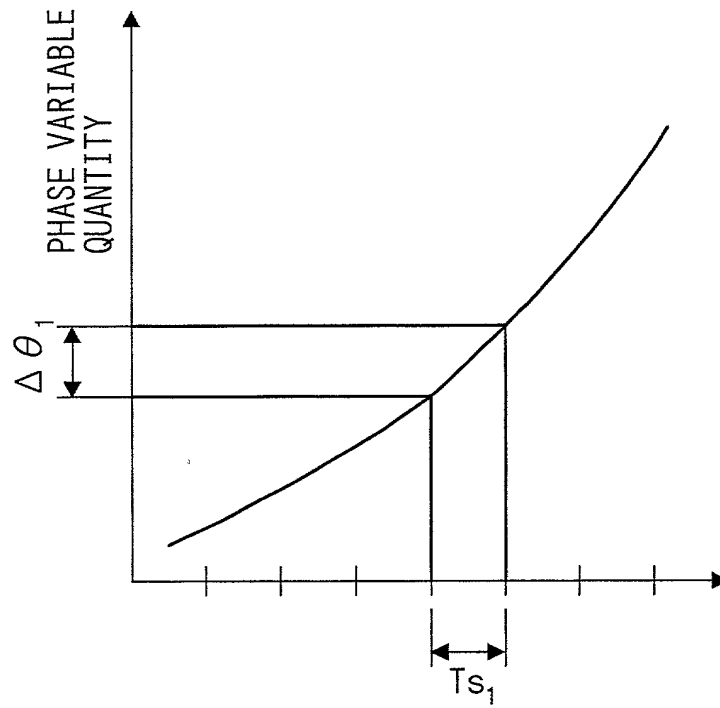


FIG. 3A

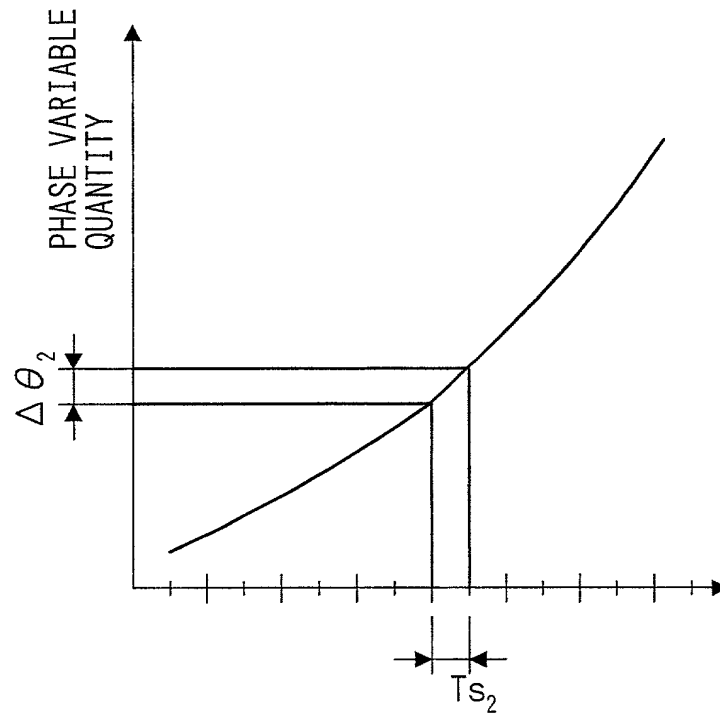


FIG. 3B

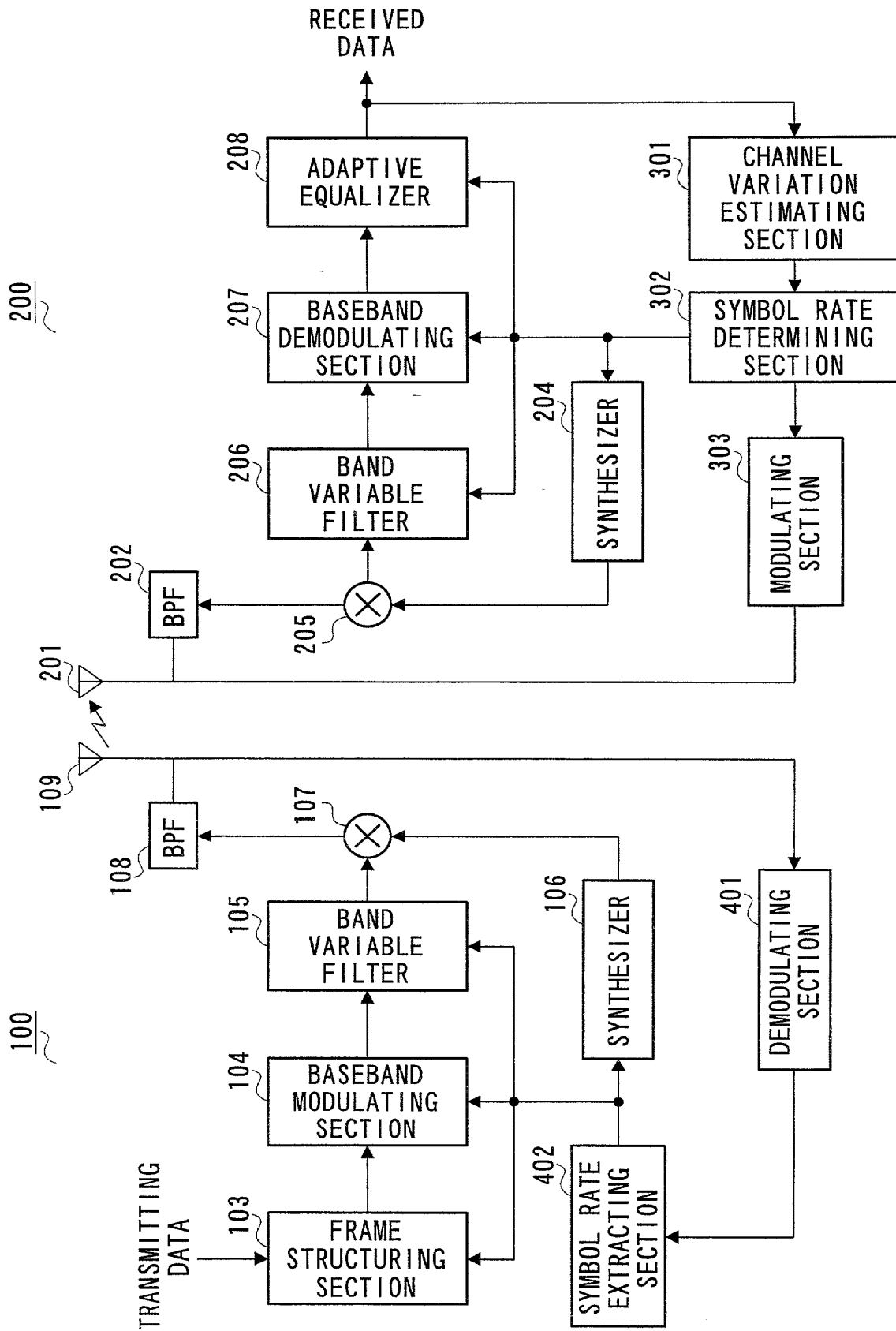


FIG. 4

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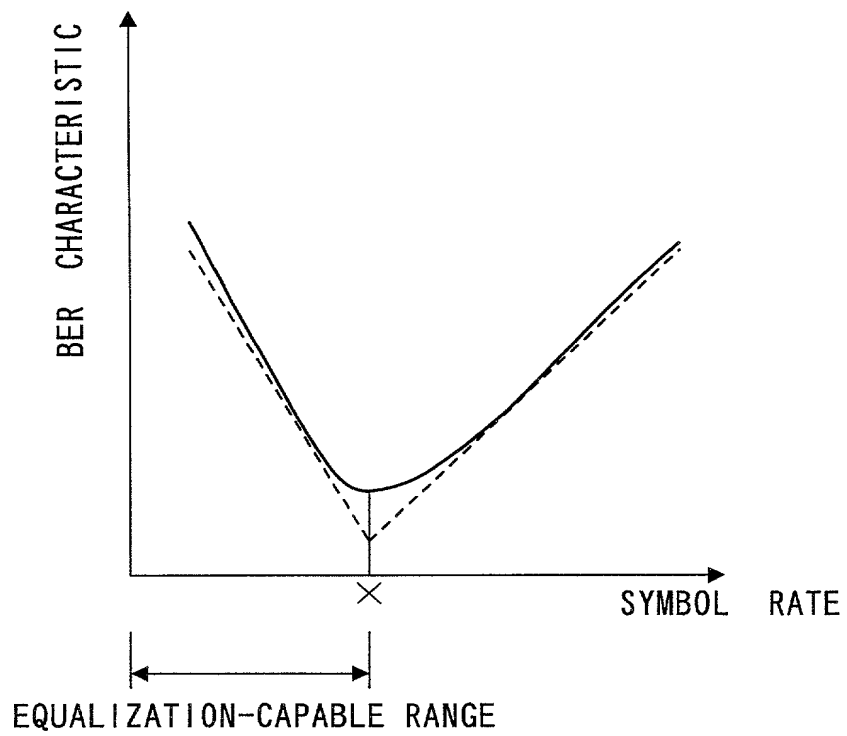


FIG. 5

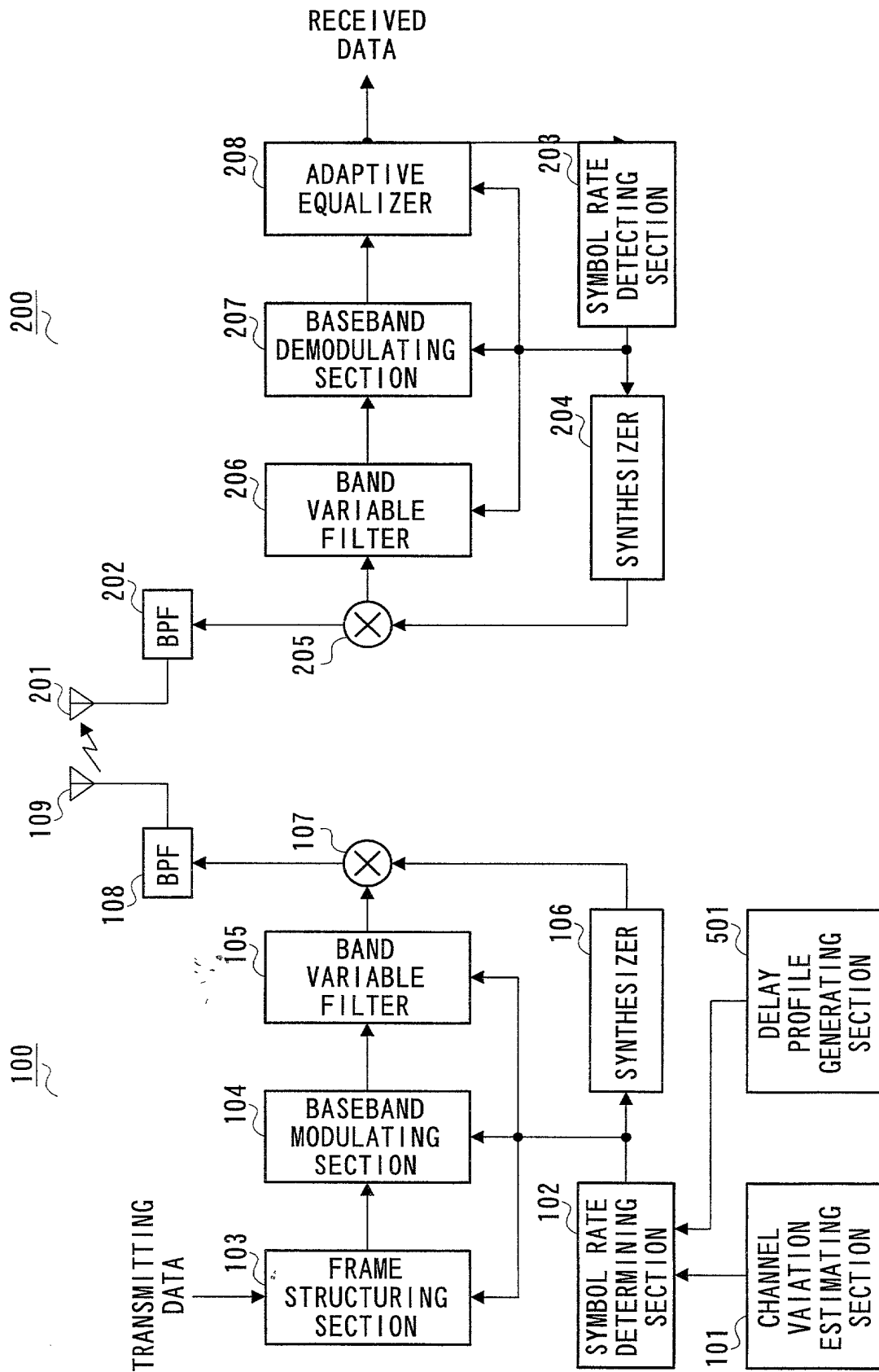


FIG. 6

APPLICATION FOR UNITED STATES PATENT
Declaration for Patent Application

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on

the invention entitled: TRANSMITTING APPARATUS AND TRANSMITTING METHOD

the specification of which 2 (file no _____)

(check at least one) 3 ☒ is attached hereto

4 ☐ was filed on _____ as (5) U.S. Application Serial No. _____

6 ☐ and was amended _____
(if applicable)

Use this portion only if you are entering the U.S. National phase based on a PCT International Application designating the U.S.	7 <input checked="" type="checkbox"/>	was filed as PCT international application	
	8	Number	<u>PCT/IP00/06541</u>
	9	on	<u>September 25, 2000</u>
		and was amended under PCT Article(s) 19 and/or 34	
	10	on	_____ (if applicable).
	11	priority date claimed in PCT International Application	
	<u>JAPAN</u>	<u>JP11-275688</u>	<u>29/September/1999</u>
	(Country)	(Number)	(Day/Month/Year Filed)
	_____	_____	_____
	(Country)	(Number)	(Day/Month/Year Filed)
	_____	_____	_____
	(Country)	(Number)	(Day/Month/Year Filed)

I hereby declare that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended, by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me which is material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date earlier than that of the application(s) on which priority is claimed.

Prior (Foreign) Application(s) any Priority Claims Under 35 U.S.C. 119			Priority Claimed	
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Country)	(Number)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Country)	(Number)	(Day/Month/Year Filed)	Yes	No

Priority Claim(s) from U.S. Provisional Application(s) – I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

Application No.	Day/Month/Year Filed	Application No.	Day/Month/Year Filed
_____	_____	_____	_____

Do not use this portion to identify a PCT application if the parent application is the U.S. National phase of the PCT application	I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between filing date of the prior application and the national or PCT international filing date of this application.		
	13	_____	_____
	(U.S. Application Number)	(U.S. Filing Date)	Status (patented, pending, abandoned)

I hereby appoint the following attorneys of the firm of Stevens, Davis, Miller & Mosher, L.L.P. as my attorneys of record with full power of substitution and revocation to prosecute this application and to transact all business in the Patent and Trademark Office:

James E. Ledbetter, Reg. No. 28732; Thomas P. Pavelko, Reg. No. 31689; and Anthony P. Venturino, Reg. No. 31674.

ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO
STEVENS, DAVIS, MILLER & MOSHER, L.L.P., 1615 L Street, N.W., Suite 850, Washington, D.C. 20036,
TELEPHONE (202) 408-5100, FACSIMILE (202) 408-5200.

See page 2 for signature lines

STEVENS, DAVIS, MILLER & MOSHER, L.L.P.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

PAGE 2 OF U.S.A. DECLARATION FORM

14a	Typewritten Full Name of Sole or First Inventor	<u>1-00</u> <u>Keiichi</u>	<u> </u>	<u>KITAGAWA</u>
		Given Name	Middle Name	Family Name
15a	Inventor's Signature	<u>Keiichi</u>	<u> </u>	<u>Kitagawa</u>
16a	Date of Signature	<u>April</u>	<u>27</u>	<u>2001</u>
		Month	Day	Year
17a	Residence	<u>Yokosuka-shi</u>	<u>Kanagawa</u>	<u>JAPAN</u>
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18a	Citizenship	<u>JAPAN</u>		
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14d	Typewritten Full Name of Sole or First Inventor			
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15d	Inventor's Signature			
16d	Date of Signature			
		Month	Day	Year
17d	Residence			
		City	State or Province	Country
18d	Citizenship			
19d	Post Office Address (Insert complete mailing address, including country)			

*Note to Inventor: Please sign name on line 15 exactly as it appears in line 14 and insert the actual date of signing on line 16. If there are more than four inventors, please add a copy of this page for identification and signatures for the additional inventors.